

IN THE CLAIMS:

Please amend claims 1, 8 and 15, and add a new claim 22 as follows:

1. (Currently Amended) In a system including a plurality of primary storage subsystems, a plurality of secondary storage subsystems that are connected to each other via a network, and a host computer including a remote copy manager (RCM) and being connected with the secondary storage subsystems, a method for remotely copying data from each of a plurality of primary volumes directly via a remote copy link to a corresponding secondary volume of a plurality of secondary volumes, wherein a number of the plurality of primary storage subsystems is different from a number of the plurality of secondary storage subsystems, the primary volumes are constituted by the primary storage subsystems, and wherein the secondary volumes are constituted by the secondary storage subsystems, the method comprising:
 - (1) a normal synchronizing procedure including:
 - receiving via the remote copy link, at each of the secondary storage subsystems, remote copy requests each of which is associated with a timestamp and directly sent from each one of the plurality of primary storage subsystems;
 - receiving via the remote copy link, at each of the secondary storage subsystems, synchronizing requests each of which is associated with a timestamp and a primary storage ID of a primary storage subsystem, which sends a respective synchronizing request, from said each one of the primary storage subsystems respectively;
 - determining, at each of the secondary storage subsystems, a first time as a first time parameter based on timestamps included in the synchronizing requests; and
 - determining, at each of the secondary storage subsystems, which remote copy requests to process based on the first time parameter, primary storage IDs and timestamps associated with the remote copy requests, thereby maintaining data I/O consistency among said storage subsystems; and
 - (2) an after-failure synchronizing procedure including:
 - suspending said remote copy requests from being directly sent from the primary storage subsystems via the remote copy link to the secondary storage subsystems after a failure occurs, thereby starting a suspension period;
 - collecting via a network link and comparing during the suspension period by the RCM in the host computer time parameters stored in the secondary storage

systems to determine a synchronized time, said network link being different from the remote copy link and not overlapping with the remote copy link;

receiving via said network link during the suspension period from the RCM in said host computer at each of the secondary storage subsystems synchronizing requests each of which includes said synchronized time;

updating during the suspension period second time parameters at each of the secondary storage subsystems up to said synchronized time; and

determining during the suspension period, at each of the secondary storage subsystems, which remote copy requests to process based on said updated second time parameter and processing a determined remote copy request by said each secondary storage subsystem therein, thereby maintaining data I/O consistency among said storage subsystems.

2. (Previously Presented) The method of claim 1, wherein the normal synchronizing procedure further includes:

performing, at each of the secondary storage subsystems, write processing in accordance with remote copy requests that are associated with timestamps indicating an earlier time than the first time.

3. (Previously Presented) The method of claim 1, wherein the normal synchronizing procedure further includes:

managing, at each of the secondary storage subsystems, a second time parameter for each of the primary storage subsystems; and

updating corresponding second time parameters at each of the secondary storage subsystems in response to whether timestamps associated with the synchronizing requests indicate a later time than the corresponding second time parameters of the second storage subsystems.

4. (Original) The method of claim 3, wherein the first time is the earliest time indicated by the second time parameters.

5. (Previously Presented) The method of claim 1, wherein the determining step in the after-failure synchronizing procedure involves updating a secondary volume corresponding to the determined remote copy request.

6. (Previously Presented) The method of claim 1, wherein the determining step in the after-failure synchronizing procedure involves selecting remote copy requests which are received by the secondary storage subsystems prior to the suspension and have a first time parameter smaller than or equal to said synchronized time to be processed so as to update a corresponding secondary volume.
7. (Previously Presented) The method of claim 6, wherein remote copy requests which are received by the secondary storage subsystems prior to the suspension and have a first time parameter bigger than said synchronized time are used to update a bitmap of a corresponding secondary storage subsystem.
8. (Currently Amended) A software residing in a computer readable storage medium for remotely copying data from each of a plurality of primary volumes directly via a remote copy link to a corresponding secondary volume of a plurality of secondary volumes implemented in a data storage system that includes a plurality of primary storage subsystems, a plurality of secondary storage subsystems that are connected to each other via a network, and a host computer including a remote copy manager (RCM) and being connected with the secondary storage subsystems, wherein a number of the plurality of primary storage subsystems is different from a number of the plurality of secondary storage subsystems, the primary volumes are constituted by the primary storage subsystems, and wherein the secondary volumes are constituted by the secondary storage subsystems, the software comprising:
 - (1) a normal synchronizing module including:
 - a module for receiving via the remote copy link, at each of the secondary storage subsystems, remote copy requests which are each associated with a timestamp and directly sent from each one of the plurality of primary storage subsystems respectively;
 - a module for receiving via the remote copy link, at each of the secondary storage subsystems, synchronizing requests each of which is associated with a timestamp and a primary storage ID of a primary storage subsystem, which sends a respective synchronizing request, from said each one of the primary storage subsystems respectively;
 - a module for determining, at each of the secondary storage subsystems, a first

timer as a first time parameter based on the timestamps included in the synchronizing requests; and

a module for determining, at each of the secondary storage subsystems, which remote copy requests to process based on the first time parameter, primary storage IDs and timestamps associated with the remote copy requests, thereby maintain data I/O consistency among said storage subsystems; and

(2) an after-failure synchronizing module including:

a module for suspending said remote copy requests from being directly sent from the primary storage subsystems via the remote copy link to the secondary storage subsystems after a failure occurs, thereby starting a suspension period;

a module for collecting via a network link and comparing during the suspension period by the RCM in the host computer time parameters stored in the secondary storage systems to determine a synchronized time, said network link being different from the remote copy link and not overlapping with the remote copy link;

a module for receiving via said network link during the suspension period from the RCM in said host computer at each of the secondary storage subsystems synchronizing requests each of which includes said synchronized time;

a module for updating during the suspension period second time parameters at each of the secondary storage subsystems up to said synchronized time; and

a module for determining during the suspension period, at each of the secondary storage subsystems, which remote copy requests to process based on said updated second time parameter and processing a determined remote copy request by said each secondary storage subsystem therein, thereby maintaining data I/O consistency among said storage subsystems.

9. (Previously Presented) The software of claim 8, wherein the normal synchronizing module further includes:

a module for write processing, at each of the secondary storage subsystems, in accordance with remote copy requests that are associated with timestamps indicating a earlier time than the first time.

10. (Previously Presented) The software of claim 8, wherein the normal synchronizing module further includes:

a module for managing, at each of the secondary storage subsystems, a second time parameter for each of the primary storage subsystems, and for updating the corresponding second time parameters in response to timestamps associated with the synchronizing requests that indicate a later time than corresponding second time parameters of the second storage subsystems.

11. (Previously Presented) The software of claim 10, wherein the first time is the earliest time indicated by the second time parameters.
12. (Previously Presented) The software of claim 8, wherein the module for determining in the after-failure synchronizing module includes a module for updating a secondary volume corresponding to the determined remote copy request.
13. (Previously Presented) The software of claim 8, wherein said module for determining in the after-failure synchronizing module includes a module for selecting remote copy requests which are received by the secondary storage subsystems prior to the suspension and have a first time parameter smaller than or equal to said synchronized time to be processed so as to update a corresponding secondary volume.
14. (Previously Presented) The software of claim 13, wherein remote copy requests which are received by the secondary storage subsystems prior to the suspension and have a first time parameter bigger than said synchronized time are used to update a bitmap of a corresponding secondary storage subsystem.
15. (Currently Amended) In a system for remotely copying data from each of a plurality of primary volumes directly via a remote copy link to a corresponding secondary volume of a plurality of secondary volumes implemented in a data storage system that includes a plurality of host computers each including a remote copy manager (RCM), a plurality of primary storage subsystems and a plurality of secondary storage subsystems, all connected to each other via a network, wherein a number of the plurality of primary storage subsystems is different from a number of the plurality of secondary storage subsystems, the primary volumes are constituted by the primary storage subsystems, and wherein the secondary volumes are constituted by the secondary storage subsystems, each of the host computers implementing said system

that comprises:

(1) normal synchronizing means including:

means for receiving via the remote copy link, at each of the secondary storage subsystems, remote copy requests which are each associated with a timestamp and directly sent from each one of the plurality of primary storage subsystems;

means for receiving via the remote copy link, at each of the secondary storage subsystems, synchronizing requests each of which is associated with a timestamp and a primary storage ID of a primary storage subsystem, which sends a respective synchronizing request, from said each one of the primary storage subsystems respectively;

means for determining, at each of the secondary storage subsystems, a first timer as a first time parameter based on the timestamps included in the synchronizing requests; and

means for determining, at each of the secondary storage subsystems, which remote copy requests to process based on the first time parameter, primary storage IDs and timestamps associated with the remote copy requests, thereby maintain data I/O consistency among said storage subsystems; and

(2) after-failure synchronizing means including:

means for suspending said remote copy requests from being directly sent from the primary storage subsystems via the remote copy link to the secondary storage subsystems after a failure occurs, thereby starting a suspension period;

means for collecting via a network link and comparing during the suspension period the RCM in by the host computer time parameters stored in the secondary storage systems to determine a synchronized time, said network link being different from the remote copy link and not overlapping with the remote copy link;

means for receiving via said network link during the suspension period from the RCM in said host computer at each of the secondary storage subsystems synchronizing requests each of which includes said synchronized time;

means for updating during the suspension period second time parameters at each of the secondary storage subsystems up to said synchronized time; and

means for determining during the suspension period, at each of the secondary storage subsystems, which remote copy requests to process based on said updated second time parameter and processing a determined remote copy request by said each secondary storage subsystem therein, thereby maintaining data I/O consistency among

said storage subsystems.

16. (Previously Presented) In a system according to claim 15, wherein the normal synchronizing means further includes:

means for write processing, at each of the secondary storage subsystems, in accordance with remote copy requests that are associated with timestamps indicating an earlier time than the first time.
17. (Previously Presented) In a system according to claim 15, wherein the normal synchronizing means further includes:

means for managing, at each of the secondary storage subsystems, a second time parameter for each of the primary storage subsystems, and for updating the corresponding second time parameters in response to timestamps associated with the synchronizing requests that indicate a later time than corresponding second time parameters of the second storage subsystems.
18. (Original) In a system according to claim 17, wherein the first time is the earliest time indicated by the second time parameters.
19. (Previously Presented) In a software system according to claim 15, wherein means for determining in the after-failure synchronizing means includes means for updating a secondary volume corresponding to the determined remote copy request.
20. (Previously Presented) In a system according to claim 15, wherein said means for determining in the after-failure synchronizing means includes means for selecting remote copy requests which are received by the secondary storage subsystems prior to the suspension and have a first time parameter smaller than or equal to said synchronized time to be processed so as to update a corresponding secondary volume.
21. (Previously Presented) In a system according to claim 20, wherein remote copy requests which are received by the secondary storage subsystems prior to the suspension and have a first time parameter bigger than said synchronized time are used to update a bitmap of a corresponding secondary storage subsystem.

22. (New) The method of claim 1, where time parameters stored in the secondary storage systems are allocated at a fibre channel switch in the network, rather than at the host computer.